

CRC A08

COOPERATIVE RESEARCH
THE ENGINE OF INNOVATION

Workshop 5.3

Promoting the Smart Country –
Education and Technology Transfer
Friday, 23 May 2008

“National issues concerning schools and school teachers as promoters of the Smart Country”



Dan Churach

*Education Manager, Centre for Sustainable
Resource Processing and Murdoch
University, Perth, WA*



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- Why education matters to the “Smart Country” – OLD and NEW
- No research without researchers
- Reaching students and the public through teachers is cost effective
- CSRP Teacher Program
- The Triangle
- The Challenge



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Some things change...



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1970 Holden Monaro
Cost \$2,394 new
Petrol = 8¢ / L

2008 Holden VE Commodore SS V
Cost \$55,290 new
Petrol = \$1.52 / L





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...and some things don't.



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Multiculturalism in Australia
Environmental stress
Oil crisis
Unpopular war
Not enough professionals

News items

1974

2008





- You already know: the downturn in career choice in STEM (Science, Technology, Engineering and Maths) subjects is particularly well documented
- Recent numbers (2005) for engineering grads:
 - China = ~600,000 (1.3 billion = **1 : 2166**)
 - India = ~300,000 (1 billion = **1 : 3333**)
 - USA = ~70,000 (300 million = **1 : 4285**)
 - Australia = ~5,000 (21 million = **1 : 4200**)
- Similar numbers in scientific disciplines

Organisation for Economic Development and Co-operation (OECD) preparation paper for June 2006 meeting in Athens

- All OECD countries experiencing turbulent enrolments, funding problems, need for more quality control, internationalisation of student bodies, and pressure on higher education to become more competitive and efficient
- No one government (party in power) philosophy is making this any different in Australia, the USA or Europe – that these things are happening everywhere is a sign of something else (other than government in power)

No research without researchers



- In a CRC, these issues have particular impact
- Too simplistic to simply say “education is the key to human resource problem”
- Equally ineffective to point out that “we need to interest more kids in the sciences” – HOW? How do we facilitate a more positive outcome?
- For a CRC such as CSRP, impossible task to reach hundreds of thousands of students with newspaper ads, CD distributions or websites
- Several pieces of educational research give some insight

Old and New: What DO we know?



Old research...

- 1972 study comparing educational approaches

A Comparison of Open and Traditional Education: Conditions That Promote Self-Concept (1972, P. T. Kohler)

- The point: TEACHERS make the difference
- Old stuff – TEACHERS are heroes to their kids, especially science teachers to students who like the STEM subjects

- Western Australian Government's 2003 Youth Survey ~8,000 12-25 year olds asked what is greatest influence of opinion
 - Parents (a lot or some = 94%)
 - Friends (a lot or some = 96%)
 - Teachers / lecturers (a lot or some = 78%)

- Australia wide DEST study (2006) supports contention that teachers have strong influence on students' course selection
- Sample of 1,830 high school students from all Australian states and territories
- Year 10 students responded that the most influential people having an impact on the selection of science subjects (i.e., making them “like sciences”) were teachers (71%)
- This was ahead of parents (66%) and peers (57%) in influencing subject selection



Science Career Inventory (SCI) – on-going work today



- On going retrospective study (Churach & Rickards) – What motivates career choice into research in mineral resource and energy sector?
- Sample ~ 250 now (Professional Postgrad and Undergrad forms)
- Deduced six motivational areas likely to influence career choices (financial, academic, relationship, lifestyle, altruistic, personal esteem)
- Open-ended survey questions, interviews and conversations with numerous professionals involved in research, academia and industry reveals insight to teacher influence on career decisions

SCI results tell us that teachers do matter



	Positive teacher influence	Negative teacher influence	Total reporting teacher influence
Undergraduate SCI	41%	27%	68%
Postgraduate SCI	39%	21%	61%
Professional SCI	40%	15%	55%

...but what of Australian teachers?

University of Melbourne 2005



- 43% of senior school physics teachers lacked a physics major
- 25% senior school physics teachers not studied the subject beyond first-year
- 30% of schools reported difficulty in filling vacancies for chemistry teachers
- 25% of all science HODs surveyed reported difficulty retaining science teachers
- 33% government school HODs concerned about ability to retain science staff
- Nearly 35% of male science teachers are at least 50 years of age
- Nearly 40% of young teachers (less than five years experience) were uncertain if they would still be teaching in five years time
- High percentage of Year 7 / 8 teachers who have not passed any university science units in biology, chemistry, physics, or in geology / earth science

“Who’s Teaching Science?”, University of Melbourne, January 2005

Has it come to this?



Posted Friday 16 May 2008 on CATALIST, the electronic bulletin board of STAWA (Science Teacher Association of Western Australia)

- “The School of Education at Edith Cowan University is providing a professional development opportunity to participate in one of two winter schools running in the second week of the July holidays (i.e., July14-18) in Joondalup.
- “The physics winter school is aimed at science teachers who may want some background on teaching the new 2A and 2B physics course of study. Innovative ways of teaching topics such as circuits, thermodynamics, wave theory, electrostatic forces, motion, friction, terminal velocity, conductors and insulators will be covered.
- “The science summer school is aimed at teachers who are teaching science out of field (i.e. did not originally train to be science teachers or middle school trained teachers. Topics covered include investigating, inquiry based teaching, occupational health and safety, setting up a rural science department and practical work from the four science conceptual outcomes. (Note this is not suitable for experienced science teachers)
- “The cost which includes morning tea and lunch is \$400 GST inclusive.”

Is \$400 plus a week of study enough to be a physics teacher?

The CSRP emphasis has been on existing teachers



- We DO realise limitations, but the CRC CAN have an impact
- Teachers already have relationships in place
- Teachers are students' heroes
- Teachers multiply good will by 150-200 each year
- Teachers have no way to know Mineral Resource Sector (or industry in general) unless a path is provided
- CRC-like organisation best broker between teachers and industry since seen as bridge linking industry-researchers-teacher and not a company recruiter
- In the end, it is word-of-mouth that sells ideas

CSRP Teacher Program to date



- Began in WA 2003, Queensland in 2005, Victoria 2008
- Collaborative effort CSRP, Murdoch University, GAMSET, QAL, Alcoa, MCA, CME, University of Ballarat and other industry partners
 - Based on understanding natural teacher curiosity, but lack of resources to satisfy interest
 - Repeated contacts with core of teachers
 - Nurture network of teachers-scientists-academics open to conversation
 - Variety of hands-on activities
 - Site visits to research / mining / processing facilities

More than 500 teachers to date

Professional development activities (PDs)



- For example, “The Chemistry and Physics of Extractive Metallurgy” – the Introductory Course
 - One-day out-of-school time
 - Brief overview of industry and career opportunities
 - Minimal “talking at”
 - Great deal of “doing and seeing”
 - Things to take back to classrooms
- Good food, good conversation, good wine and cheese wrap-ups



- Comminution – crushing and grinding
- Screening and sorting
- Gravity separation
- Magnetic separation
- Electrostatic separation
- Froth Flotation
- Variability of ores





- Leaching
- Solvent Extraction (SX)
- Electrowinning copper and gold
- Fauxite ©
- Assaying samples
- Atomic Absorption (AA)
- “The gold spatula” back to classroom





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Pyrometallurgy



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- Tin smelt
- Viscosity of molten metals
- Tin pour
- Thermite Reaction





- Properties of minerals
- Identification scheme for identifying minerals based on physical properties:
 - lustre
 - Colour
 - Streak
 - Hardness
 - Specific gravity
 - Special properties
- How these relate to the extraction process



- “Down to Earth Series”
 - Rock Back in Time
 - Palaeotraveller
 - Metal Matters
- Oresome Froth
- Also do Mineral Processing and Geology activities at these sessions





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Industry and Research Provider tours



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- Industry site-specific tours
- CSIRO Waterford Minerals tour
- Curtin Atomic Force Microscope
- Murdoch University Pilot Plant





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A variety of other activities



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- “Advanced” PD – Rock to metal in a day
- 90-minute PDs (Copper, Alumina, Mineralogy)
- Community lectures
- Teacher research projects





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Does it work?



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- How do we measure effectiveness?
- Supportive teachers are self selecting
- Great written and verbal feedback from teachers
- A few teachers have opted into met research



Teacher feedback concerning PDs



- Actions speak louder than words:
 - All done on individual teacher's own time
 - Continually come back for more - many have done 4, 5, 6 activities
 - Dialogue open between teachers-scientists
 - Half a dozen teachers now studying Extractive Met
- Surprisingly has been two-way street
 - Industry and researchers interested in teachers
- Teachers relate work to curriculum and get help through the network
- CSRP PhD research project looking at effects of teacher program



Responses to 16 survey items



Q. No.	Question Topic	Before PD	After PD	Shift
1	My mining & MP knowledge is good	2.50	3.64	1.14
2	I would recommend M & MP as a career	3.98	4.47	0.48
3	I have a positive attitude about mining	3.94	4.38	0.44
4	Mining & MP solves environmental problems	3.45	4.05	0.59
5	I use mining & MP examples in class	3.17	4.03	0.86
6	I know a mining & MP scientist I can contact	2.92	4.05	1.13
7	Mining & MP is a high tech industry	3.94	4.47	0.53
8	Mining & MP offers exciting careers	3.95	4.56	0.61
9	I talk to colleagues/friends about M & MP	3.09	3.80	0.70
10	The M & MP industry cares for environment	3.41	3.89	0.48
11	Doing hands-on activities helps understanding	4.06	4.64	0.58
12	I would recommend M & MP as a uni major	3.22	4.20	0.98
13	My view of M & MP researchers is positive	3.89	4.48	0.59
14	M & MP PDs help to be a better teacher	3.75	4.47	0.72
15	Any industry PD helps to be a better teacher	3.86	4.42	0.56
16	Content PDs help to be a better teacher	4.06	4.52	0.45



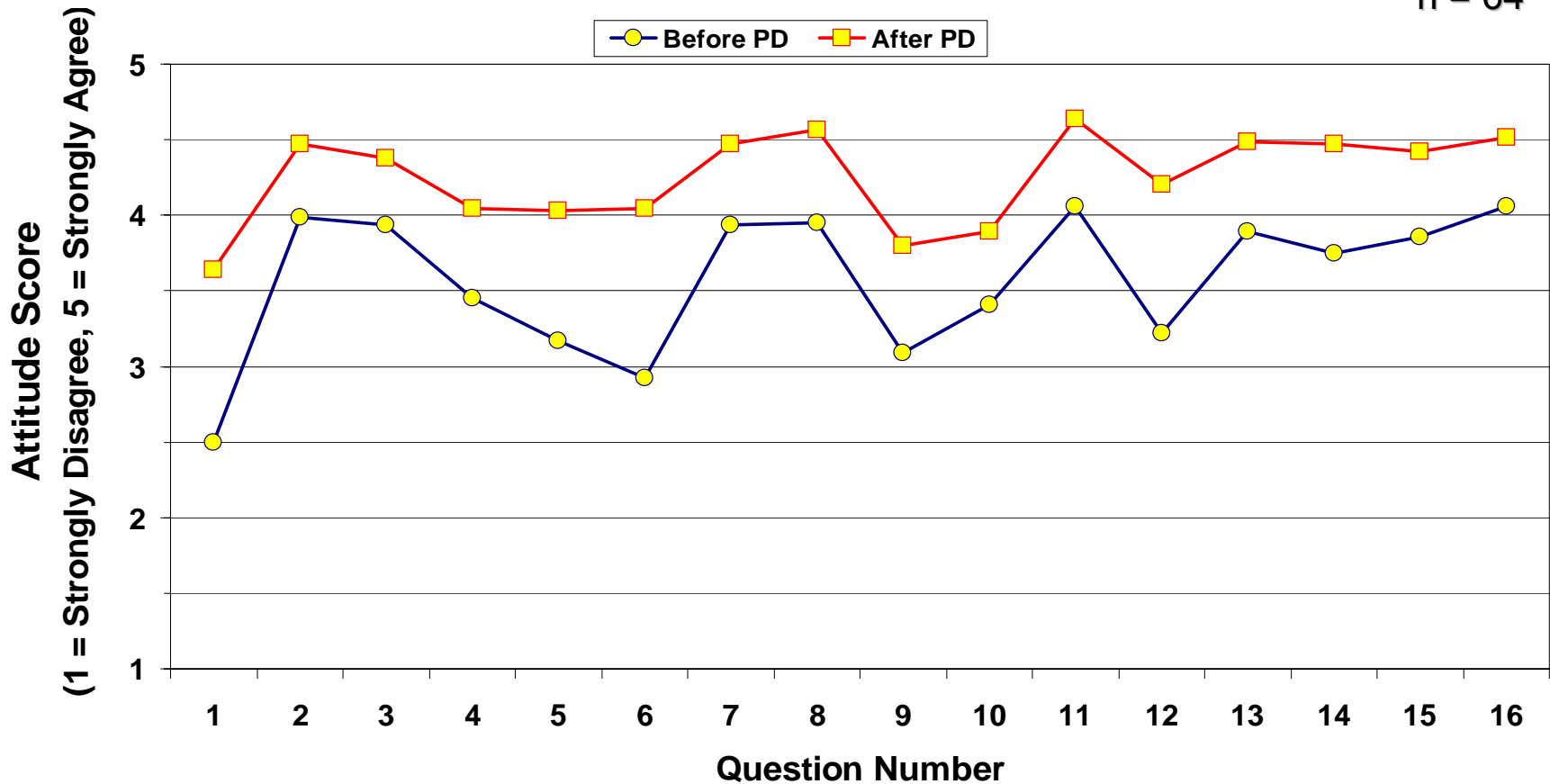


Attitude shifts of 16 survey items



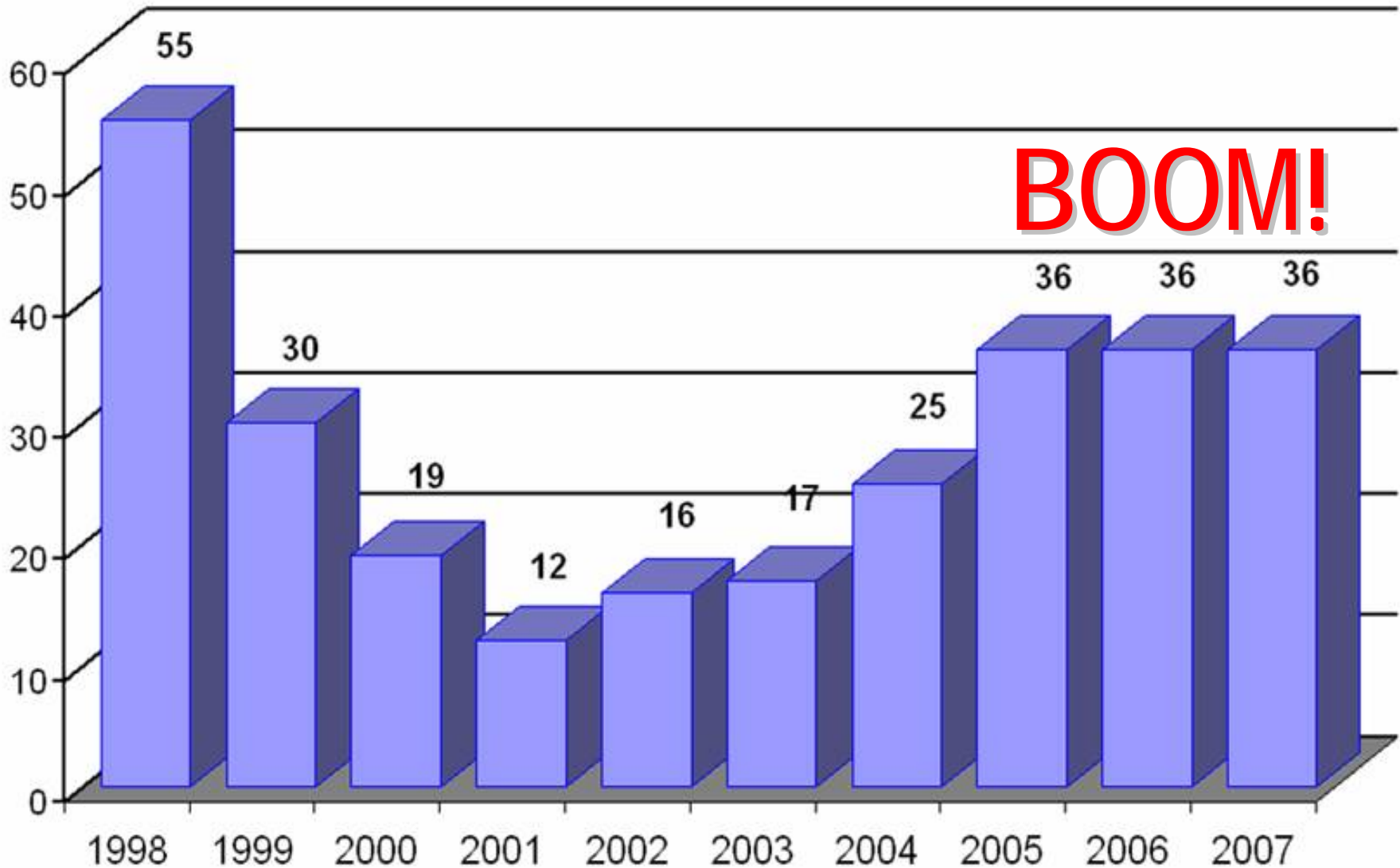
Teacher Attitudes Towards Mining & Minerals Processing Industry Before and After Professional Development

n = 64



- The “old days” (1980s) at both Murdoch and WASM would have seen first year classes of 60-75 or more
- Obviously first years based on many things, but first Murdoch teacher program began in 2002 and collaboration with CSRP began in 2003
- Can directly track half a dozen students past few years
- Amazing how word of mouth works
- The boom works against us – these increases are in spite of lowest unemployment rate ever!

Murdoch University: Undergrad 1st year Mineral Processing enrolments





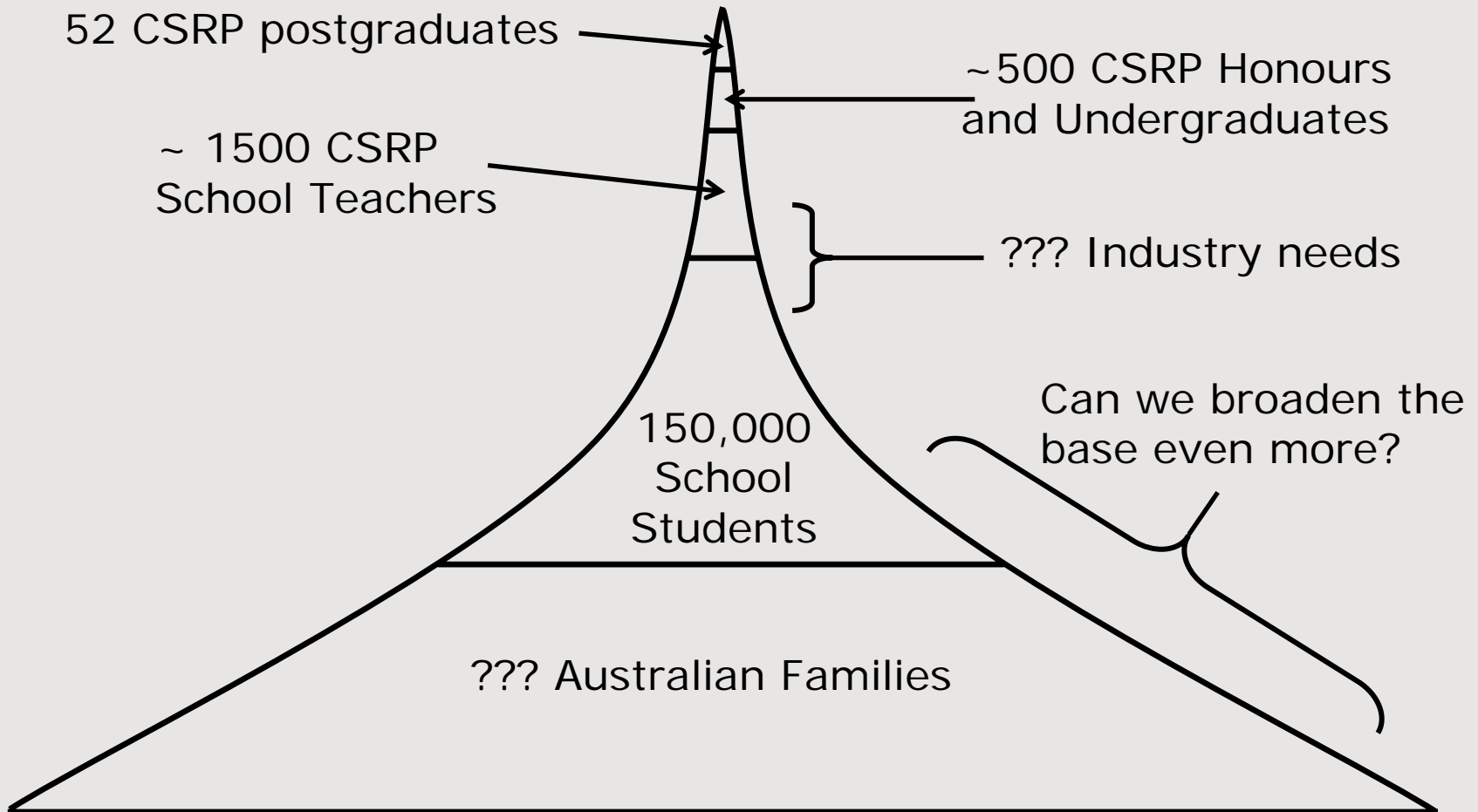
Where to from here?



- Continue Collaborate with current partners
 - Murdoch University, Ballarat University, Science Teachers Association of Western Australia, Smart Geelong Region Local Learning and Employment Network, Education Queensland, Gladstone Area Mathematics-Science-Engineering Teachers, Minerals Council of Australia, WA Chamber of Minerals and Energy
- New collaborations with other innovative programs where possible
- Continue to expand industry base
- Develop wider PD sessions
- More industry / site visits
- Involve Student Teacher and Diploma of Education students
- More disciplines – the network exists and teachers want more experiences within ALL applied science areas
- Opportunity for ALL CRCs

That's ALL CRCs!

How big does the triangle need to be?



A rising tide lifts all ships

- Look at triangle, CSRP only need 52 postgraduates over 7 years
- Our industry doesn't need many extractive metallurgy grads
- If we really can reach 100,000 thousand or more students, imagine how much ALL science and engineering disciplines will benefit
- Hence, the “rising tide...” reaches

ALL CRCs





A rising tide lifts all ships

- Look at triangle, CSRP only need 5 postgraduates over 7 years
- Our industry doesn't need extractive metallurgy
- If we really can raise a thousand or more students how much ALL science and engineering disciplines will benefit
- Hence, the "rising tide..." reaches

ALL CRCs

The CHALLENGE



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QUESTIONS



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University, Perth, WA*